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ABSTRACT

How best to introduce computer mediated communication (CMC) technology to kindergarten through grade 12 educators was studied in Maine. Faculty from the University of Southern Maine (Portland) offered a 1-week institute in global computing as part of a 3-credit graduate education course. Participants had the entire semester to develop and implement class-based global computing projects. They were expected to communicate with university project staff 10 times during the semester through electronic mail logs. Participants were 35 elementary school and secondary school teachers, librarians, computer coordinators, and administrators, of whom 22 completed questionnaires at the final meeting. Six examples of participant projects are given. Findings indicate that some participants gained enough knowledge and confidence to introduce skills and concepts in their classrooms. The difficulties that prevented many participants from completing their projects were identified. The most noticeable was the anxiety many students displayed at the initial workshop. Several technical problems surfaced related to mainframe use and user support. It was apparent that both the university and the public school systems were not yet prepared to facilitate the entry of these educators into the world of CMC. Seven tables present study findings. (Contains 11 references.) (SLD)

Instructing K-12 Teachers in Computer Networking

AND

K-12 Instructional Practices in Computer Networking:

Linking Teachers and Students to the Global Village

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Instructing K-12 Teachers in Computer Networking

INTRODUCTION

Computer Mediated Communication (CMC), the sending and receiving of information using a personal computer and the telephone system, is booming in colleges and universities. It is expected to promote curriculum exchanges, improve student learning, and reduce feelings of teacher isolation in elementary and secondary schools in the foreseeable future (Merseth,1991: Reil,1986; Kerr and Hiltz, 1982). It follows that it is important to learn how to teach K-12 educators how to use CMC to further educational objectives.

This study was conducted to address the question of how best to introduce CMC technology to K-12 educators. Although the professional literature addresses the appeals of interactive networking for teachers, there has been a paucity of training protocols for the design and implementation of both CMC instructional materials and an instructional design. Nonetheless, research on introducing microcomputers into schools has been frequently characterized by reports of stress and self doubt inherent in the learning of technical and mechanical skills.

Telecomputing and Education

Computer Networking for K-12 is an empowering learning tool. According to Gevirtz & Kelman (1990, p. 10) over seventy-one percent of the larger school districts in the United States use some computer networking. The term network describes the electronic transfer of text messages from one person to another or to a group of individuals where the form of exchange is printed text on a computer screen (Merseth, 1991). Users at terminals are not directly connected but gain access by logging on to one computer on a network from which they can reach others. One of the more popular networks is called the Internet. It is a group of interconnected national, regional, and campus networks that use the same communications protocols (Arms,1990).

Computer networking has been cited for its many advantages within education. Included among these are the teacher's ability to have students work as a group; improved capability to assess the progress of students; money saved on duplicating peripherals and software; access to hundreds of local, national, and international data bases and courseware in such subjects as biology and English; and opportunities for teleconferencing among people world wide.

Telecomputing in Maine

Telecomputing has emerged in the past few years as a topic of discussion for improving Maine's public schools. Governor John McKernan has argued that a comprehensive approach to integrating technology with education is needed to improve communication and collaboration among teachers in the state. He has also argued for the use of technology and telecommunications as a catalyst for advancing economic opportunities in an increasingly competitive world economy. Others, like the directors of the Maine Computer Consortium and the Southern Maine School Partnership, consider the idea of connecting K-12 school personnel through electronic links to the University of Southern Maine a sensible one because networking is seen as fundamental to improving learning environments for students and the professional environment of teachers.

Despite the groundswell of support for telecomputing in Maine's schools, CMC has not been locally implemented outside the U. Maine system of higher education. A survey conducted by the investigators of this study revealed that although a few districts in the greater Portland area had started local area networks (LANS), none had succeeded in getting linked to the Internet. A key problem in linking schools and Internet has been cost. Access to Internet can be expensive because when it is set up to maximize benefit to education, it requires a dedicated phone line, a fee for being connected to Internet, and charges for data transmission. In addition, technology must be provided so that <u>multiple</u> computers at a school access the Internet simultaneously, in order to achieve substantive academic impact. Technical support for these activities is often in short supply. Another problem in connecting schools to global computing resources is the need to help teachers and students to understand its usefulness for content specific curriculum.

Access is but one of the barriers to unlocking the potential of telecomputing in Maine's schools. Current telecomputing technology is difficult to learn and use, especially for the novice computing user. Minimum requirements for training must be met before wide range applications are effected (Tinker,1991).

METHOD

Course Description and Setting

In order to respond to the challenge of providing CMC technology to K-12 educators in Maine, three University of Southern Maine faculty offered a one week institute in global computing, during August of 1992. Each participant in the global computing course was given a user access id and password on the university mainframe computer for a one-year period. This gave them access to the Internet, which the state-wide public university system is linked to.

The institute, offered for graduate credit, was designed to be a hands-on experience in computer networking. It emphasized the potential uses of the technology including:

1) the promotion of curriculum exchanges through teacher to teacher electronic sharing of classroom experiences and instructional ideas;
2) the improvement of student learning through collaborative projects such as electronic penpals and joint writing with other students around the world;
3) the reduction of teacher isolation through links to world-wide communication resources including the access to on line libraries and to university mentors.

Special features that were built into the institute concept were:

* step-by-step instruction in the use of electronic mail
* guest speakers
* a pre-institute workshop to prepare participants for the experience

* two post-institute sessions to allow participants to report on what they were doing with their newly acquired CMC competencies
* on-site technical support (Joyce and Showers,1980; Griffin,1980) following the institute was provided

<u>Course and Project Time Frames</u>

This 3 credit graduate education course was developed around a full-time one week workshop for the participants. The activities during each project phase were as follows:

Pre-Workshop

* meetings with a sampling of area K-12 computing coordinators on the need for the course and the roles they might play in delivery and support
* meetings with the Director and the research staff member of the Southern Maine Partnership -- a grant funded partnership between USM and many southern Maine school systems
* a meeting with a focus group of area school teachers who had expressed an interest in integrating computing into their classes
* a meeting with the director of the Maine Computing Corsortium, a K-12 support group
* a survey of computing hardware and software resources in area schools was conducted

The Workshop

* substantial amount of lecture, discussion, and computer based demonstrations
* many hands-on exercises, with staff support, both within and outside of the class time
* use of guest speakers in specialized areas of interest to participants

Post-Workshop

* Students had the complete fall semester to develop and implement their class based global computing projects
* Students were expected to communicate with project staff ten times during the semester, using E-mail **logs**; reporting on any aspect of their global computing activities
* On-site support was provided, even beyond the semester, by project support staff
* Two class meetings were scheduled during the semester; one was for sharing, problem solving, and support; the other was for project presentations and course wrap up
* A survey was administered at the final class meeting
* Project and course grading was then done
* Survey results, E-mail logs, and project content were then analyzed as part of the project evaluation.

Assumptions and Objectives

The institute was team taught, using demonstrations on computer projection systems, along with extensive hands-on activities. The pedagogical strategies for instruction were grounded in theories of adult learning and communication (Gagne, 1977; Dick, 1981). The progression of competencies developed followed the structure of knowledge to be learned. For instance, since the mainframe was the computer environment, participants were introduced to Xedit, the word processing system, before they were introduced to E-mail. They were introduced to E-mail before listservs, listservs before FTP.

The primary objective was simple: to introduce K-12 educators to computer networking so that they and their students could benefit from it. The instructors assumed that computer networking operates as a medium for communication, in that sense, functioning much like a crayon, a telephone, or broadcast system. As such, it holds enormous potential for human use and it is the potential as much as anything else that students need to recognize, think about, and work with.

Research in communication technology (Sproull & Kiesler, 1991) teaches us that new technology cannot be approached as if one knew in advance just how people would use it. The instructors assumed that the greatest good would emerge if they could convey to the participants the potential of this new tool and set them loose to find their own uses. Hence the objectives were as follows:

* To develop competencies in computer networking;
* To introduce the participant to some of the possibilities--e.g., online library search, gopher, ftp, listserv, names file, kidsnet, a catalogue of printouts taken from

networking;

* To have each participant plan and execute a use of computer networking connected to her/his teaching (or library work or computer specialist work), through the vehicle of the course project.

Participants

The participants in the institute were a mix of thirty-five K-12 teachers, librarians, computer coordinators, and administrators. Their average length of experience in education was 10.5 years. Their reasons for taking the course varied; some took it to fulfill continuing education credit requirements, some to gain access to a mainframe, and some out of interest in learning about computer networking. Sixty percent of the respondents had never used electronic mail before taking the course. Of the forty percent who had used E-mail before, over half had used it frequently. Thirteen percent of the participants had little or no experience of any kind with computers. Most of the participants were used to working with Macintosh-based interactive programs that guide users with menus and icons. They were not prepared for the frustration of navigating the somewhat obtuse command line based environments provided by the mainframe and the MS-DOS based PC's.

Instructors

The instructional team consisted of three University of Southern Maine faculty members and an undergraduate staff associate. One instructor was a Professor of Education with an interest in adult literacy and the potential of CMC in the public school system. The second instructor was a Professor of Business, Economics, and Management with extensive experience in teaching computer use in higher education and in the business world. The third instructor was a Professor of Communication who had used CMC in his own research work and in connection with teaching. The staff associate was an undergraduate who was majoring in computer science.

Data Collection

The primary research questions were chosen to provide the investigators with a better understanding of the training issues inherent in teaching CMC competencies to K-12 educators. If more could be learned about the specifics of the learning tasks involved in computer networking, insights could then be used to define efficient training protocols. In specific terms, answers to three questions were sought:

1) Did the participants develop the intended competencies?

2) What types of problems were encountered by the instructors and participants?

3) How did the participants go about using CMC skills in their work?

Three types of data collection were employed: student electronic mail logs, end of course questionnaires, and analysis of course projects. Due to the exploratory nature of the study, analysis of that data was limited to frequencies and cross-tabulations.

Electronic Messages

Participants were asked to get online at home or in their classrooms to exchange electronic mail with the instructors and others a minimum of ten times. The E-mail logs were printed and analyzed for content. Each message was analyzed to determine the types of user problems encountered and steps taken to solve them. Forty-seven specific categories of problems and/or activities were coded, which were then collapsed into five major categories. The details appear in a subsequent section titled "Log Data".

Questionnaire

The questionnaire, consisting of 19 questions, focused upon the nature of participant learning during the institute and on implications for teaching CMC to K-12 educators. The instrument consisted of a mixed assortment of two option questions, inventory and rating scales and open ended techniques.

Course Projects

Each participant was required to design and carry out a project in which K-12 students would be involved in computer networking, or which involved the work they do at the school, e.g., librarian. The course project required the institute to maintain contact with participants after the formal class meetings ended. During this time, participants continued to learn CMC, to stay in touch with the instructors and the technical assistant, and they supplied the instructors with the ten E-mails discussing their networking activities.

RESULTS

Questionnaire Data

Twenty-two participants completed questionnaires at the second and final post-institute meeting in October. Data from the questionnaire were tabulated for frequency of response.

Competencies and Values Developed

In order to determine what competencies were developed, participants were asked to rate their skills against fifteen items. The table below provides percentages of the responses to each competency category.

Question: **As a result of taking this course, how much would you say you know about:**

(All values are expressed as percentages)

	Great Deal	Fair Amount	Little	Nothing	No Response
Accessing mail utilities	9	59	18	9	5
Creating messages	41	45	14	--	--
Saving files	32	36	23	9	--
Changing files	14	45	32	9	--
Deleting files	23	55	18	5	--
Sending and receiving mail	45	41	9	5	--
Creating a names file	23	50	18	5	5
Accessing bulletin boards	14	32	41	14	--
Linking to other mainframes	18	32	23	27	--
Teleconferencing	--	14	41	45	--
Printing documents	18	18	45	14	--
Getting on and off topical mailing lists	9	32	45	14	5
Using remote library systems	14	14	50	23	--
Trouble shooting communication package problems	9	18	36	32	5
Getting on line in the classroom or at home	32	36	23	--	9

TABLE 1

One can see from Table 1 above that, from the participants perspectives, some skills were learned and some were not. If one combines a "fair amount" and a "great deal" learned, one gets a picture of what and how much participants believed they learned. Clearly, sending and receiving mail, saving files, deleting files, creating a names file, and getting on line in the classroom or at home were skills that the participants felt they had learned. (In every case, at least 68% of the respondents believed that they learned a fair amount or more about each.) Skills that participants did not feel so confident about learning were trouble shooting communication package problems, using remote library systems, getting on and off topical mailing lists, printing documents, teleconferencing, and accessing bulletin boards. (At most, 46% felt that they learned a fair amount or more about any of these.) The remaining skills were ranked in an intermediary position: linking to other mainframes and changing files.

Value

The survey addressed the question of value by asking the participants to rank how useful telecomputing would be in promoting teacher to teacher exchanges, improve student learning and reduce teacher isolation. More than eighty-five percent ranked these categories as helpful. In a related question close to seventy three percent of the participants checked "ALL" to the question about who should take the course.

Difficulties

The instructors wished to pinpoint the difficulties participants encountered during and after the institute so that improvements could be made for future offerings. A number of questions were designed to get at this issue. First, participants were asked if they thought the instruction was sufficient. Close to sixty percent answered in the affirmative. Nine percent checked "NO" while the remaining twenty eight percent checked the mixed response category. (Because this question was open ended, a number of responses were mixed, stating that in general it was sufficient, but also expressing specific concerns.)

The second question (also open ended) asked the participants to list what helped most (or would have helped) in learning about computer networking. Of the twenty-three recommendations offered, two were checked more than twenty percent of the time: more command handouts (27%) and a readable guide to networking (23%). Items thought to be associated with effective learning, such as relevant connected material, time to experiment, and one-on-one teaching were checked less than 5% percent of the time. Because the question allowed respondents to express what was done well and/or what should be done better, the low scores for those categories might be interpreted as satisfaction with those factors.

Another way to gain insight into the adequacy of instruction was to ask participants what advice they would give to someone taking the course next summer. The responses were very surprising because commonly accepted recommendations such as, "don't delay hands on," "ask questions," "know access issues," "know the PC side," and "take detailed notes" were not made. Instead, the most frequent recommendations related to modems and to practice of skills (i.e., "buy modems," and "practice"). Another surprise included the almost unanimous consensus to add a pre-institute workshop to the course the next time it is offered, where those wanted to meet in advance of the classes could to begin to prepare for the course. (Although the instructors had planned such a workshop prior to the first summer, they were later convinced that it was unnecessary and would be poorly attended.)

Uses

A primary question of the study was to determine how participants would use CMC skills in their work. Close to twenty-three percent of the participants reported using E-mail daily, and another forty-five percent reported using it between 1 and 3 times a week. Thirty-two percent of the participants (of the 22 questionnaire respondents) used the network less than once a week.

When asked to indicate what they used CMC for, the leading reason participants gave was to access information from afar. While they were clear about using CMC for getting information from others, they did not use it as much for social talk, to write or to themselves. Understandably, at the time of filling out the questionnaire, they were less certain about using CMC technology for teaching. At that point, participants had only been back in their classrooms for a few months and were still learning their way around computer networking.

Log Data

As mentioned earlier, all participants in the course were expected to communicate with the instructors ten times during the fall semester, using electronic mail logs. The content requirements of the logs were not highly structured. In fact, participants were told to address any project or course related problem or interest, and to use the logs as a method of telling the faculty how they were doing. In practice, 24 participants of the 35 originally enrolled sent at least one e-mail communication, for a total of 262 log communications.

Utilizing this data for analysis presented some difficulties. As noted above, the content was not structured, because the faculty believed that this would create more learning value and motivation. Logs could range in length from a few sentences to multiple pages; there were often multiple topics covered in one log.

Two students independently coded the logs. They were given a set of categories to work within, assigning the primary topic of interest within the log to the appropriate predefined code. They were also asked to record other data regarding each log. Was the participant reporting about success, failure, or neither? They were asked to code a more specific phrase to describe the purpose of the log. Participant ids were also tracked to associate a series of logs with each participant.

The categories did not prove to be as helpful for research as they were for working with the participants. The faculty then developed five grouping codes, into which all others could be placed. Using both the categories and the more extensive descriptions coded by the students, they then placed all log events into a topic area.

Topic area Description	Total Number of Logs	Success (expressed as percents)		
		Yes %	No %	Neither %
1. On-the-Internet Issues	85	78	22	0
2. Course Related Business	70	84	11	4
3. Local Mainframe Issues	43	44	53	2
4. K-12 School Based Issues	50	68	32	0
5. All Other Issues	14	64	36	0
TOTALS	262	71	27	2

Table 2

Although the number of failures being reported in the logs is relatively low, the instructors had an opportunity to further review the nature of those failures. Because the data included the date of each log and the code of the specific participant, the instructors could track responses over time to see if problems were solved. The method was straightforward: if a student reported a failure in one of the very specific categories, and later reported a success in that same category, it was reasonable to assume that the barrier had been overcome. In those cases, one log was subtracted from the failure column each time it happened. Resulting data appeared as follows:

Topic Area Description	Success (expressed as percents)	
	Yes %	No %
1. On-the-Internet Issues	86	14
2. Course Related Business	95	5
3. Local Mainframe Issues	49	51
4. K-12 School Based Issues	74	26
5. All Other Issues	69	31
TOTALS	79	21

Table 3

The following is a listing of specific issues by topic area:

Topic Area 1 -- On-the-Internet Issues			
about Ursus	9	Eric	2
Telenet	3	Archie	2
Princeton Shareware	3	Bulletin boards	3
Micro Muse	4	Bitnet	1
Listservers	5	Carl through Ursus	2
Internet	5	Cosndis/Edutel	2
KidCafe	2	Use of CIT	1
Kidsnet	18	FTP activity	14
Kidleader	1	Gopher	4
KidLink	1	Send FMI	1
FredMail	1	Global E-mail	1

Table 4

Topic Area 2 -- Course Related Business			
Peer helping	6	Project issues	6
Instruction	1	E-mail activities	30
Course issues	27		

Table 5

Topic Area 3 -- Local Mainframe Issues			
Professional Responsiveness	7	Modem Issues	3
General Problems	1	Mail Browse	1
Logon ID's	1	File retrieval problems	4
Full disks	10	Command syntax	16

Table 6

Topic area 4 -- K-12 School Based Issues			
Apple/MAC issues	10	Connectivity	21
Financial resources	5	Hardware	4
Local Involvement	1	Red Ryder software	2
Site issues	1	Use in classroom	2
Use with teachers	4		

Table 7

Topic Area 5 -- All Other Issues			
General log	1	Addresses	6
Unknown transactions	7		

Table 8

Project Data

The third and final way to indicate what we think our participants learned is to display how they used the course content in the projects they were required to do. What follows is a selected sample.

Project Example 1

One participant, a computer instructional specialist at a high school, joined forces with some faculty at her school and applied for a grant to fund hardware for CMC. The grant was funded.

The new equipment is for faculty to learn CMC and ultimately for students to learn CMC. The faculty will design a multi-disciplinary project (including science, social studies, math, english, alternative education, french, german, spanish, latin, and special education).

The various faculty are discussing ways in which they want their students involved with the Internet. Some of the language teachers are discussing keypals in their corresponding countries. Kidsnet will be used to inform others of the local adventure. The history class hopes to have the foreign language class write a request to distribute to a foreign country.

Project Example 2

A middle school teacher in Biddeford, Maine, attempted to connect to students in Bideford, England. She explained in her term project, "Historically, the early settlers of Biddeford, Maine, came from Bideford, England, in 1616. The two communities are today about the same size, and both are coastal." Although the teacher was never able to make a computer link with Bideford, England, she believed that the experience of the attempt had many benefits for her and her students.

Project Example 3

A social studies and computer teacher, frustrated by the lack of resources available for connecting students to life in other places of the world, used the course to try to overcome the scarcity of cultural exchange in Maine. She used her project to locate a group of french speaking students who would write to a group of french students at the local high school where she taught. While she reports considerable effort without real success in connecting kids to french speakers, she does also report discovering a world news in french through E-mail.

Project Example 4

A high school librarian reported on how she used the computer networking course to help students to locate resources without leaving the building. She writes: "Internet provides the opportunity to access library collections in the next town, the next state, or the next country. Students using Internet find that we can develop resources far beyond the limits of our collection and become a library without walls." Hence, her project was simply to teach students to access academic library collections and thereby to develop stronger library research skills.

She goes on to describe the project with this example:

> "Certainly, one student symbolizes for me the success of this project. Kevin had already written a paper on the dust bowl and been told that it needed more focus.

He appeared uninterested when we sat down together online. I already knew that most of the resources on the 1930's had been checked out and wanted to try the USM collection, but he said he'd never get to Portland. We searched the Bowdoin collection until we found primary publications of the soil conservation corp and then we discussed how these could be used to focus his paper. I wasn't sure what he would do after that, but the next week was pleased to be told that he had turned in his best work for the year."

That encapsulates the potential of telecomputing.

Project Example 5

A teacher at a private high school offered her knowledge of computer networking for her students in much the same way we did. She simply helped them learn the basics of computer networking and more or less set them free. This is a simplification, since she first held group meetings to discuss the possibilities with the students and set up groups that then worked to get started. She reported that students took to the idea of networking and zoomed right passed her. Her emphasis was on the student initiated uses of CMC. She writes:

> "I asked students what they were learning from networking. Students said they were learning how to talk to people from different places and by doing this they are learning more about computers in general. Students are also learning how to send mail more easily and learning how to access information services. Some students said you can find lyrics of songs. Something they are very interested in."

It is interesting to see how much of the value this teacher notes is tied to issues that are outside of computer use per se. She notes effects of networking on motivation to learn, self initiated learning, and communication. She continues:

> "I find students enjoy computer networking because they are very natural in their conversations. Students in high school are very concerned about their appearance and it sometimes inhibits them from really being them. On the computer students are not self conscious. Students can also talk to students more easily through the

computer because there are not age barriers. Students are very mature when they are on the network, they feel that this is a real privilege."

Finally, this teacher summarizes her observations of this project by observing that students are learning more than she expected. This may well be a critical factor in CMC, the potential of the experiences for students.

Project Example 6

A third grade teacher taught his students to use Internet so that they could have an electronic keypal from another state as a resource in researching information on the various states in the U.S.A. His objective was for his students to learn about geography, climate, and economy, as well as to learn to use a new channel of communication to acquire information. He enlisted volunteer parents to help in this project. He taught the parents to use E-mail and they came in several times a week and worked with individual children. While finding keypals was difficult, he managed to find some by putting out messages on various listservs. Each of his children wrote to at least one correspondent and received a reply.

The classroom took part in a live IRC chat with a classroom in Iowa on election day. One of the students gets messages from Australia. Some of the students are involved in a math contest that originates in El Paso, Texas.

DISCUSSION

What Was Learned

In these results and in the examples of how the participants applied the knowledge of CMC to their work, a few main ideas stand out. First, some of the participants were able to acquire enough knowledge and confidence in using CMC to introduce these skills and concepts into their classrooms. Second, they were able, in a short period of time, following the course to produce some success. That is, they could use CMC well enough to produce situations that encouraged them and their students to go on with CMC. Third, the instructors observe that often the participants used CMC to offer their K-12 students resources. This is a strong theme in many of their projects. Moreover, K-12 students are offered information and people resources within a context of self-directed learning, i.e., they get to decide just where they want to go with it, what they want to find out, and just how they will interact with the system. A kind of empowerment is at work here. Fourth, the instructors observe in these projects that traditional lines of demarcation are broken. Not only is the student introduced to new ways of thinking of space and time because of the nature of the new communication medium, but he/she has new collaborators in learning and new powers in accessing information.

Value

It is apparent that the participants, once introduced to the basic ideas of computer networking, learned that there is enormous potential bringing computer networking to the public school system. There was no resistance to the practical value of linking teachers to teachers, students to students computer users to information. This is posited on the basis of the data reported and on discussions with the participants in the classroom, during breaks, via e-mail, and based on the motivation observed in their efforts to learn to use the equipment and to overcome technical difficulties.

Sources of Difficulties

It is difficult to know exactly why so few finished their projects, but a few ideas stand out. Probably the most noticeable problem was the level of anxiety exhibited by the participants during the first two days of the course. User interfaces which were acceptable to the instructors were not acceptable to the participants, many of whom probably never had to learn the specialized nature of command-line driven software. Many were very quiet. Others were quite manic as they encountered difficulties with the commands such as when they were confused about being located in MAIL or in FILELIST, or worse, accessing one from within the other. Indeed, mainframe software is difficult to use and time consuming for learners accustomed to a point and click user interface. The participants told the staff and instructors in very explicit ways that it was anachronistic, unfriendly, and difficult to learn. As one of the participants wrote in his paper "The archaic mainframe methods . . . need to be brought up to 1990's standards with more menu choices, better on-line help, and more PC/Mac compatibility. While we understand that the nature of the mainframe will not allow it to act entirely like a Macintosh, it certainly could be a lot easier."

It is possible that because the technology was so difficult to learn, a number of participants tended to delay using CMC and got behind answering mail and withdrew from activities. They may not have reached the point at which the benefits outweighed the petty inconveniences of learning to use the technology.

Problems were exacerbated by the greater technical experience of the computer coordinators in the institute which made it difficult at times for the instructors to respond to the needs of the less experienced. The novice learners complained that they needed more time to feel comfortable in working with CMC. In contrast, the more experienced participants in the class, many self taught, frequently had other complaints. Another source of confusion related to keyboard mapping; the keys functioned differently in class than they did at the school/home site. Other lessons learned suggest that the Internet was not successfully implemented by many of the novices until their conceptual and technical problems were addressed on site by the staff associate from the institute. In most cases, novices who had been isolated from others were less active in solving problems than those who worked together.

One course problem is concerned with nature of team teaching itself. For example, none of the three faculty participating was the manager. Good intentions often went unrealized, like the making of additional handouts and overheads. The faculty often found themselves compromising to accommodate each other, when assertive disagreements might have led more quickly to enhanced course presentation.

Furthermore, the faculty were new to the teaching of CMC and were unprepared for many of the difficulties that arose. Among the problems were judging the use of classroom time and estimating the difficulty of various tasks, skills, and concepts for the participants. (In fairness, the experienced computer professor knew these things, but could not dissuade the others from their mission.) Simply stated, the instructors did not have enough time or inclination to reconcile differences over instructional design decisions, and to make materials for the institute. One result was that participants were required to read and comprehend a poorly written technical manual. Again, in fairness to the faculty, the manual was about all that existed in comprehensive form at the time. Since then, in this past winter, several texts on learning Internet have appeared.

Technical Problems

The number of technical problems encountered during and subsequent to the Institute were relatively few, and can be narrowed to specific areas. These areas include: the CMS platform vs. the PC, keyboard mapping, availability of the necessary hardware, and the so-called "full disk" problem.

Because our participants are required to go through the mainframe computer at USM to access the Internet, having at least a rudimentary knowledge of the CMS operating system is necessary. While most, if not all, of our participants were fairly comfortable using their PC's (i.e. IBM compatible, Macintosh), the command processes of the CMS environment are significantly different. Although the basic command structure is not terribly difficult to master, there is a degree of reluctance in most computer users to deviate from the familiar. A possible solution to this problem may be found in bypassing the CMS system altogether. This solution would require a significant investment in equipment at the participating schools (i.e. networking hardware). Although the actual connection to the Internet would still be through the university mainframe, the CMS layer of commands would be eliminated.

The problem of keyboard mapping is somewhat more complicated, but not unresolvable. When a computer with a modem and a phone line is used to access the mainframe, it is necessary to choose a "terminal emulation." A terminal emulation is what allows the user's micro computer to become essentially a part of the mainframe computer. The mainframe is capable of accommodating several terminal emulations, and most pc-based software allows at least two or three. All telecommunications software has associated with it a "keyboard map," depending on the terminal emulation chosen. A keyboard map determines the signal that is sent when the user presses a given key on the keyboard. Unfortunately, there is some variance among the various computer platforms, software packages, and terminal emulations. Since our participants were not only using different types of computers, but different telecommunications software among the computers as well, unexpected results occurred. For example, the key for "quit," or discontinuing a given process on the mainframe is the F3 key; however, in some cases pressing the key produced unexpected results or an error message (i.e. F3 undefined.) The solution to this problem lies in either changing the keyboard map to send the desired signals or ensuring that all participants are using the same telecommunications software. While changing the keyboard map is possible with most software, it usually requires some programming skill. The solution that seems to make the most sense is to have the participants all using the same software for their respective machines.

The availability of the necessary hardware and phone access is less of a technical problem than it is one of economics. Of the participants that already had the equipment or managed to acquire it, the difficulties encountered were far fewer than expected. This can be attributed to the fact that those that already had modems had used them before, and the documentation that accompanied new equipment was adequate.

The "full disk" problem can be traced to two specific causes: lack of available disk space, and excessive mail. Each participant was allotted approximately 600 kilobytes of disk space, equivalent to about 2 floppy disks. While disk space is not unlimited on any computer, the participants have the option of obtaining more for a fee. The abundance of mail received by some participants was caused by subscriptions to what are called a listservers. A listserver is an e-mail address designated as a distribution center for those having interests in a particular topic (e.g. k-12 education). All mail received at such a site is then redistributed to all subscribers. Subscribing to one of these services can result in dozens of pieces of mail per day, which in turn can result in filling disk space very quickly. This problem was amplified for some participants due to the fact that they subscribed to such a service during the week of the Institute and did not get "logged on" again until a month later. In some cases, the amount of mail had accumulated in excess of 150 pieces. A solution to the mail problem might be found in having a local distribution site, rather than having each participant receive every communication from a given service. Participants could then selectively receive mail, thereby reducing individual demands on disk space. In any case, subscribing to a very active listserver requires that one log on and check mail often to avoid the full disk problem.

Additional Problems

The participants learned that both the university and the public school systems in southern Maine were not prepared to facilitate their entry into the world of CMC. At every point along the way, frustrating setbacks were experienced in the mechanics of getting onto overcrowded mainframe connections, getting responses from personnel at the computer center, receiving computer identifications from the system operators, gaining support at the local school level, and the like. The participants learned that none of the instructors was completely prepared in advance to solve, without some real difficulty, the sorts of technical problems that arose. Keyboard mapping, hardware/communication-software matching, phone line connections, and full disks easily discouraged all but the most determined. The participants learned, in short, that the university and K-12 school system in Maine were not yet set up to make CMC easy to introduce to the public schools.

CONCLUSION

It is appropriate at this point to go back and summarize what was found with relation to the three questions asked at the outset.

Did the participants develop the intended competencies?

The instructors observed that some of the participants were able to acquire enough knowledge and confidence in using CMC to introduce these concepts and skills into their classroom (although it must be noted that approximately 50% of the institute participants did not complete the requirements of the course, such as doing the project and sending us Email 10 times).

What types of problems were encountered by the instructors and the participants?

There were a number of technical problems instructors and participants had to deal with. Since they were learning CMC at the university site, problems arose in transferring the learning to the home site, where keyboard mapping differences existed, where finding the right software to communicate with the mainframe became an issue, where telephone line access was often problematic, where using the command language of the university PCs on a Macintosh computer required considerable translation.

Participants encountered problems associated with the mainframe. They often encountered a full disk on their mainframe id. This required them to learn how to purge the disk of some files to open up space. This turned out to be a serious stumbling block for many for a long time. They encountered problems of acquiring mainframe user ids for local support people. Often the person in charge of granting these ids was slow to respond and hesitant to give out ids.

The instructors observed a tension in the course between teaching the material by means of a step-by-step "cookbook" approach and a conceptual or abstract approach. Many participants requested a cookbook approach; i.e., "tells us what to type and in what order". However, later, when participants bumped into problems, the instructors noted that the cookbook approach did not equip them with the knowledge needed to transfer learning and to generalize. The course never did successfully address this dilemma. The instructors taught intuitively, each within his own style. And they wondered if the mix caused learning problems.

How did the participants go about using CMC skills in their work?

Our participants were able, in a short period of time following our course, to produce some successes. That is, they could use CMC well enough to produce situations that encouraged them and their students to go on with CMC. We observe that often our participants used CMC to offer their K-12 students resources. This is a strong theme in many of their projects. Moreover, K-12 students are offered information and people resources within a context of self-directed learning, i.e., they get to decide where they want to go with it, what they want to find out, and just how they will interact with the system. A kind of empowerment is at work here. We observe in these projects that traditional lines of demarcation are broken. Not only is the participant introduced to new ways of thinking of space and time because of the nature of the new communication medium, but he/she has new collaborators in learning and new powers in accessing information.

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